भारत सरकार, रेल मन्त्रालय

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

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Specification for Energy Efficient Multi-Genset 2400 / 1600 BHP BG Diesel- Electric Locomotive

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CONTENTS

Descriptions		Page Nos.
Schedule		-
Chapter - 1	Scope of supply	1
Chapter - 2	Design requirements	6
Chapter - 3	Description of items to be retained and in the scope of supply of Indian railways	9
Chapter - 4	Description of items in new scope of supply and to be procured from the tenderer	11
Chapter - 5	Testing & inspection	17
Annexures		
I	Floor frame assembly drawing A- (WDM3D) for WDM2G B- (WDS6ADT) for WDS6G	
II	General arrangement drawing A- (WDM2G) B- (WDS6G)	
III	Traction Motor characteristics	
IV	Tractive Effort vs speed curve A- (WDM2G) B- (WDS6G)	
V	Dynamic brake characteristics(WDM2G)	
VI	Maximum outline dimensions	
VII	Tentative list of parameters to be monitored through remote diagnostics	

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Abbreviations

- 'IR' means Indian Railways.
- 'RDSO' means Research Designs and Standards Organization, Ministry of Railways, Manak Nagar, Lucknow-226 011.
- 'DLW' means Diesel Locomotive Works, Varanasi-221 004.
- 'BG' means 1676 mm gauge, referred to as Broad Gauge.
- 'BHEL' means Bharat Heavy Electricals Ltd, Bhopal or any of their works in India.
- 'IEC' means International Electro-technical Commission.
- 'IS' means Indian Standard.
- 'AAR' means Association of American Rail-roads.
- 'UIC' means Union International Des Chemis defer (International Union of Railways)
- 'IRS' means Indian Railway Standard.
- "US EPA" means United Stated Environmental Protection Agency
- Throughout this specification the words:
  - Horse Power (HP) shall be taken as metric horse Power, i.e. 75 kg metre/sec.
  - Tonnes (T) shall be taken as metric tonne i.e. 1000 kg.

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Schedule

Energy Efficient Multi Genset 2400 BHP (WDM2G) / 1600 BHP (WDS6G) broad gauge diesel-electric locomotive having nominal axle load of 19.5 (WDM2G) / 21 tonne(WDS6G) tonne, complete in all respects, shall be assembled with:

1. Under frame of new WDM3D for WDM2G / WDS6ADT for WDS6G locomotives shall be used. The firm shall provide details of the modifications to be carried out to integrate the offered equipment on the under frame. The under frame shall be in the scope of supply of IR.
2. Bogies of WDM3D for WDM2G / WDS6ADT for WDS6G locomotive shall be used and shall be in the scope of supply of IR.
3. ~~GenSet - Three nos. each with In-Line, 4-Cycle, 6-Cyl, Cummins QSK-19, N-Gen II type diesel engine coupled with alternator~~

   GenSet - Three nos. each with In-Line, 4-Cycle, 6-Cyl, Cummins QSK-19 type diesel engine coupled with alternator model no. 740RSL4046
4. DC traction motors type TM4907 or equivalent.
5. Intelligent Microprocessor based electronic control system for power generation, traction motor supply and controlling.
6. A high voltage DC Chopper to provide propulsion power to each traction motor separately for enhanced adhesion control.
7. A common equipment blower for cooling the traction motors, DC Choppers, DC Rectifier, Low Voltage Power Supply and Electric Cabinet Pressurization.
8. 64-74 VDC power supply for battery charging and low voltage control. A DC to AC inverter to convert 64-74 VDC to 115 VAC for RV type heating, ventilation and air conditioning (HVAC) power as well as 24 VDC for Low Voltage Gen-Set Control.
9. Extended Range dynamic braking system with Grid Current Control for WDM2G.
10. One electrically driven oil cooled air compressor.
11. Existing IRAB1 Air brake system or (CCB for WDM2G)

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Specification for Energy Efficient Multi-Genset 2400 / 1600 BHP BG Diesel-Electric Locomotive

Chapter 1

1.1 Background

Indian Railways plans to manufacture 2400HP environment-friendly, fuel-efficient, multi (3) gen-set locomotive. The manufacturing work shall be done by DMW/Patiala.

1.2 Scope

The scope of this specification covers the design, manufacture & supply of power, control & associated equipment including necessary engineering & supervision work.

Complete list of the equipment to be supplied/retained along with the responsibility matrix is given in the following table:

Sl	Item	To be retained	New scope of supply	Modification engineering concept/OGA drg./Routing, Interface etc.	Detailed drgs. for modification/ application	Executing agency	Remarks
1.	Underframe & underframe layout	New layout needed	√	Contractor	~~RDSO~~ DLW	DMW	New underframe of WDM3D for WDM2G / WDS6ADT for WDS6G shall be used. Softcopy of the ~~layout~~ underframe drawing can be obtained from ~~RDSO/LKO~~ DLW. Tenderer shall integrate the offered equipment on this underframe and indicate modifications required on the underfame. DMW shall procure a new underframe with all the modifications needed.
2.	Fuel tank	√	X	-do-	~~RDSO~~ DLW	DMW	Existing ~~underframe and~~ fuel tank of WDM3D for WDM2G / WDS6ADT for WDS6G shall be retained. The tank shall be supplied by IR.
3.	Fuel oil system including suction from fuel tank & piping	X	√	Contractor	Contractor	DMW	The tenderer must indicate the piping arrangements and location of filters needed to supply fuel to the three / two gen-sets.
4.	Fuel and lube oil filters	X	√	Contractor	~~RDSO~~ Contractor	DMW	Details for the piping etc shall be provided by the tenderer.
5.	Complete motorized bogie with brake rigging	√	X	X	RDSO	DMW	Bogies frames of WDM3D / WDS6ADT locomotive shall be used. Modifications

DRAFT

	and fittings						needed to suit the offered design shall be indicated by the tenderer by way of detailed drawings.
6.	Carbody cabling (except internal & interconnecting cables, material for scope of supply of contractor	X	X	Contractor	Contractor	DMW	Standard E-beam cables are used by IR. The same cables shall be retained. The tenderer shall make itself familiar with the design specs of these cables. IR shall procure the cables. The detailed layout of the cabling for electrical equipment shall be furnished by tenderer.
7.	Cables (except carbody cables)	X	√	Contractor	Contractor	DMW	Cables attached to/part of the electrical equipment shall be supplied by contractor.
8.	Diesel Engines	X	√	Contractor	Contractor	DMW	Details of engines placed at para 4.4.
9.	Engine cooling and lubrication system	X	√	Contractor	Contractor	DMW	Piping layout/ filter placements (that is external to the modular assembly) shall be indicated by the tender. Procurement of pipes etc shall be made by IR based on these details.
10.	Engine hood & superstructure	X	√	contractor	contractor	DMW	Engine Hood / superstructure to be replaced in its entirety and to be supplied by the successful contractor.
11.	Battery system	X	√	Contractor	RDSO	DMW	Details of existing batteries used on IR locomotives is placed at para 3.7. IR shall procure these.
12.	Headlights	√	X	-----	-----	DMW	All lights except the headlights will be replaced with new LED lighting.
13.	Flasher light, marker lights etc.	X	√	Contractor	Contractor	DMW	
14.	Carbody filter motor-blower	X	√	Contractor	RDSO	DMW	Existing filter motor-blower arrangement shall be replaced. Drawings of equipment to be supplied by contractor.
15.	~~Superstructure~~	~~X~~	~~√~~	~~Contractor~~	~~RDSO~~	~~Contractor~~	~~Existing long hood shall be replaced. To be supplied by the successful contractor.~~
16.	Painting and Styling	√	X	DMW/RDSO	-	DMW	PU painting to be done by IR.
17.	Crossover walkways, Bottom step	√	X	~~RDSO~~ Contractor	~~RDSO~~ DLW	DMW	Existing shall be retained.

DRAFT

18.	Coupler, draft gears and ~~pockets~~ side buffer	√	X	RDSO	RDSO	DMW	Existing shall be retained.
19.	Air Brake system and emergency brake	√	X	-------	RDSO	DMW	Existing air brake system shall be retained. Details placed at para 3.5. The piping etc shall vary depending upon the loco design and placement of compressor, the piping layout shall be furnished by the tenderer.
20.	Vigilance control device	√	X	Contractor	RDSO	DMW	Contractor to integrate existing system. Specn. obtainable from RDSO.
21.	Dynamic brake (forWDM2G)	X	√	Contractor	RDSO	DMW	Location to be indicated by the tenderer.
22.	Air compressor	X	√	Contractor	RDSO	DMW	Inverter-motor driven oil cooled compressor to be used. Details at para 4.11. Layout of compressor and piping to be furnished by Contractor. Compressor to be supplied by contractor.
23.	Main Reservoir	√	X	RDSO	RDSO	DMW	Existing air reservoirs to be retained.
24.	Gauges & Fittings	√	√	Contractor	-	DMW	Gauges that are specific to the design of the new loco are to be provided by contractor. Rest of the standard gauges shall be retained.
25.	Sanding system	√	X	------	------	DMW	Existing equipments shall be retained. Tenderer to integrate with their offered loco control system.
26.	Cab & short nose	X	√	-----	contractor	DMW	Existing Cab and Short Nose to be replaced.
27.	Control console	X	√	Contractor	RDSO	DMW	Existing control console shall be replaced.
28.	Alternator	X	√	Contractor	Contractor	DMW	Description placed at para 4.7
29.	Traction motor	√	X	RDSO	RDSO	DMW	Details of Traction motor placed at para 3.8
30.	DC chopper; 350 kW (min.) capacity, 1800 Volts (max.), 1600 A chopper for power supply to TM's	NA	√	Contractor	RDSO	DMW	Details at para 4.8
31.	Auxiliary power	X	√	Contractor	Contractor	DMW	Details at para 4.9

DRAFT

	systems with auxiliary inverter						
32.	Microprocessor based control system	X	√	Contractor	Contractor	DMW	Details at para 4.13
33.	Event recorder and Speed indicator	√	X	RDSO	RDSO	DMW	Existing equipment shall be used. Contractor must integrate this with the offered control system.
34.	Remote diagnostic system	√	X	Contractor	RDSO	DMW	Optional. Details at para 2.3.3
35.	Air-conditioning system.	X	√	Contractor	RDSO	DMW	Tenderer shall offer suitable system and integrate with the ~~existing~~ loco cab.

1.2.1 The multi-genset locomotive shall be built using a new under frame of a WDM3D for WDM2G / WDS6ADT for WDS6G locomotive. The successful tenderer shall provide details of the modifications required to integrate the offered equipment on this underframe. The supply of this underframe shall be in the scope of IR and DMW may source it from trade/DLW. Details of the new equipment, equipment of the existing loco to be retained as well as design scope of the tenderer has been indicated in the table given above.

1.2.2 The scope of material supply by the successful tenderer shall include the following major assemblies. Apart from supply of these items, the successful tenderer shall be required to submit detailed engineering drawings for successful integration of offered equipment with existing loco platform.

a. Three nos. Gensets for WDM2G / Two nos. Gensets for WDS6G (Engine with alternator and accessories as detailed in para 1.2.3)
b. Complete microprocessor based control system (Hardware and Software)
c. Auxiliary power system with auxiliary machines and controls
d. Dynamic braking system
e. Suitable electric driven compressor.
f. Blowers for traction motor, traction control equipment.
g. Rectifier/suitable DC chopper to feed current to traction motors.
h. Gauges and meters specific to offered design.
i. Drivers cab & short nose
j. Contactor compartment
k. Various parts of the hood over engine & superstructure
l. Control console
m. Air-conditioning system
n. Internal cabling of the electrical equipment.
o. Modification/engineering/concept drawings for system integration.

The actual assembly work shall be undertaken by Indian Railways as per the integrated drawing (indicating location/fitment of various equipment) submitted by the tenderer.

1.2.3 Tenderer shall provide a self-contained modular design of the equipment. Diesel engine, alternator, chopper/rectifier, radiator fan, fuel pump motor, starter motor and lube oil / water tank along with the cooling/lube oil system shall be integrated in a single assembly frame of each Genset which is ready to be mounted on the underframe.

1.2.4 To increase the haulage capacity the locomotive may be used in a multiple unit (MU) operation. In this case, MU couplers shall be provided by IR as per RDSO specification. The loco control system shall be programmed to establish an MU operation with upto 3 locos. The successful tenderer shall provide the wiring details for the MU configuration.

DRAFT

1.2.5 Notwithstanding what is mentioned in this specification, the firm shall have to quote and supply all the necessary equipment for satisfactory functioning of the multi Genset locomotive except the items that are within scope of IR and indicated at table A.

1.2.6 All piping shall be supplied by IR, except special hose/ pipes which shall be supplied by tenderer. The details of the special hoses should be furnished in the offer.

1.2.7 Qualifying Criteria- Offers from only those tenderers who are established loco builders and have experience of at least 5 years in rebuilding / manufacture of new locomotives shall be accepted. The firm shall have its own design of multi-genset locomotive and shall have manufactured and supplied at least 200 locomotives with multiple generator set technology of 1800HP and above range which shall have performed satisfactorily. Documentary evidence for the same shall be furnished by the successful tenderer himself.

1.2.8 The successful tenderer shall have its own design and manufacturing of the locomotive computer control system. The firm shall have complete facilities for fabrication, assembly and commissioning of the modular generator structure and shall also have appropriate test facilities for the same. The facilities of the firm shall have the requisite AAR and ISO quality accreditations.

1.2.9 The successful tenderer shall also have a clear memorandum of understanding with an Indian firm, such that;

1. The Indian firm has access to technical knowhow of the parent firm.
2. The Indian firm shall provide effective after sales service for the Multi-genset locomotive.
3. The firm shall assist / give technical support to DMW at the time of manufacture of the locomotives.
4. The firm shall act as a single window for IR for all technical and commercial matters.

1.2.10 The Indian firm selected for MOU must satisfy the following;

1. The firm must have an annual turnover of at least INR 250 million.
2. The firm shall be capable of absorbing technical know-how for design and manufacture of the Multi-genset locomotive.
3. The firm should have been involved in design and manufacture of major equipments for the existing Diesel electric locomotives of IR.
4. The firms shall have basic infrastructure for fabrication and designing with qualified personnel.

1.2.11 In case the Indian partner of the locomotive builder submits the offer, clause 1.2.7 to 1.2.10 must be satisfied.

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Chapter 2

Design requirements

2.1 Environmental conditions

2.1.1 Complete multi Genset locomotive shall be required to work continuously at full load under following atmospheric conditions:

Maximum temperature (Atmospheric)	(i) 55 ºC (under sun). (ii) 47 ºC (in shade) (Temperature inside locomotive may reach 55 ºC.)
Minimum temperature (Atmospheric)	- 20 ºC.
Humidity	90 % (Up to 100% during rainy season.
Altitude	Max. 1200 meter above mean sea level
Refernce site conditions	(i) Ambient temp. 50 ºC (ii) Temp. inside engine compartment 55 ºC (iii) Altitude 160 m.
~~Annual rainfall~~ Rainfall	~~Between 1750 mm to 6250 mm.~~ The locomotive shall be designed to permit it's running at 5 Km/h in a flood water level of 10.2 cm above the rail level.
Dust	Extremely dusty and desert terrain in certain areas. The dust content in air may reach as high a value as 1.6 mg / m³.
Atmospheric conditions in coastal areas in humidity salt laden and corrosive atmosphere	All the equipment shall be designed to work in coastal areas in humidity salt laden and corrosive atmosphere. (a) Maximum PH value : 8.5 (b) Sulphate: 7 mg / litre. (c) Max. concentration of chlorine: 6 mg / litre (d) Maximum conductivity: 130 micro Siemens/ CM.

2.1.2 Complete system shall be suitable for rugged service normally experienced for rolling stock where locomotives are expected to run up to a maximum speed of 130 km/h (WDM2G) / 65 km/h (WDS6G) in varying climatic conditions existing throughout India. Complete multi GenSet loco control system shall be protected from dusty environment by providing well sealed enclosures. Necessary precaution should be taken against high degree of electromagnetic pollution anticipated in the locomotive. The cooling system shall be designed to take care of tilting and centrifugal forces which would normally be encountered in service.

2.1.3 All the equipment and their mounting arrangement shall satisfactorily withstand the vibrations and shocks ~~normally encountered in service as indicated below~~ test as per IEC 61373:

~~a) Max. Vertical acceleration - 1.5 g~~
~~b) Max. Longitudinal acceleration - 2.5 g~~
~~c) Max. Transverse acceleration - 1 g~~
~~*('g' being acceleration due to gravity)*~~

DRAFT

All the electronic equipment and their mounting arrangement shall be designed to withstand vibrations and shocks as specified in IEC-60571.

2.2 Major design requirements of the multi-GenSet locomotive are indicated in the table 'A' as below:

TABLE - A

Sharpest curve to be negotiated Single unit without buffer Double unit with buffer	174m radius and 1 in 8½ turnout in either direction.
Locomotive weight Nominal Axle Load	~~112.8~~ 117 T ± 2% (WDM2G) / 126 T ± 2% (WDS6G) ~~18.8~~ 19.5 T(WDM2G) / 21 T (WDS6G)
Wheel diameter (mm)	1092 mm (new) 1016 mm (condemning)
Gear ratio	65:18 (WDM2G) 74:18 (WDS6G)
Maximum operating Speed. (The loco shall be tested at 135 kmph(WDM2G) / 75 kmph(WDS6G) to get cleared for an operating speed of 120 kmph(WDM2G) / 65 kmph(WDS6G) Minimum continuous speed Maximum designed speed	120 kmph (WDM2G) 65 kmph (WDS6G) 18 kmph(WDM2G) / 15 kmph (WDS6G) 135 kmph(WDM2G) / 75 kmph(WDS6G) (Loco to be tested at this speed)
Starting Tractive Effort (Minimum) at half worn wheel profile.	37 Tons (WDM2G) / 30 Tons (WDS6G) minimum. With Tetra-mount bogie and at 117 Tons weight with 32.8 % adhesion (minimum) for WDM2G With Trimount bogie and at 126 Tons weight with 32.8 % adhesion (minimum) for WDS6G
Installed power under standard conditions	2400 (WDM2G) / 1600 (WDS6G) HP (at AAR conditions)
Power input to traction (under site conditions)	2150 THP(WDM2G) /.....THP(WDS6G)
**Tractive effort Vs Speed characteristics	RDSO graph. See Annexure-IV A & IV B
Audible Noise Requirements	Shall not be more than that in existing IR locomotives.

** The successful tenderer must match these parameters or better this.

2.2.1 The weight of the locomotive must be contained as indicated in the above table 'A' of Chapter 2 of this specification. The weight of the equipment not in the scope of supply by the tenderer

DRAFT

shall be approximately 70 tons. Weight breakup of all the offered equipment shall be furnished by the tenderer and the final weight of the locomotive shall have to be contained within ~~112~~ 117(WDM2G) / 126(WDS6G) tons ± 2%. Weight distribution calculation shall be submitted by the successful tenderer to Indian Railways (RDSO) for evaluation.

2.2.2 The tenderer shall indicate speed potential of the locomotive, Tractive Effort vs. Speed characteristics of the locomotive, starting adhesion etc. For this purpose traction motor characteristics is placed at annexure-III. These values shall not be less than that indicated in the above table 'A' of Chapter 2 of this specification.

2.3 Design / Details of Modification

2.3.1 The locomotive shall be manufactured on the under frame of WDM3D for WDM2G / WDS6ADT for WDS6G locomotive. The design envisages three nos. small Gen-Sets. with output at 240 Volt, 60 Hz @ ~~1800~~ 2100 rpm. The voltage of each alternator shall get added when each generator starts.

2.3.2 The locomotive shall use diesel engines that are at least U.S. EPA Certified at Tier II Off-Road emissions levels. Horsepower and rpm levels for each engine shall be controlled in order to achieve even better emissions and fuel consumption rates. Start/stop functionality shall be managed to minimize engine idling. The operation of each engine shall be so sequenced so as to equalize the running of each multi gen-set.

2.3.3 (*Applicable for WDM2G)

Remote diagnostics (optional feature): Locomotive shall be equipped with remote diagnostics wherein critical locomotive health data and other important parameters along with GPS location information as per annexure VIII should be available to maintenance depots or anyone else in the real time. It is required to transfer the data from the locomotive microprocessor control system at regular intervals to a central database using commercially available CDMA or GSM cellular networks. Indicative list of parameters to be monitored is placed at annexure-VII. Change in the list of parameters shall be permissible with mutual consent. The tenderer may integrate the loco control system with the existing remote diagnostics of IR (REMLOT), the specifications of which can be obtained from RDSO by the successful tenderer. Alternatively, the contractor may provide its own proven system of remote diagnostics with the approval of RDSO. The contractor shall have to share its communication protocols with IR.

2.3.4 Operator-Initiated Self Test feature shall be provided to allow verification of system operation.

2.3.5 Successful tenderer shall be fully responsible for proper mounting, installation and commissioning of all the offered equipment as well as satisfactory performance of the locomotive in the field.

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Chapter 3

3.0 Description of items to be retained and in the scope of supply of Indian railways.

The items given below shall be retained in the locomotive to be converted. These items are not in the scope of new supply and need not be quoted for by the tenderers. The tenderer shall make itself aware of the existing systems of the locomotive and shall provide the layout/integration to ensure proper integration of the equipment offered on the existing loco platform.

3.1 General arrangement and Equipment layout *(layout drawing to be given by tenderer)*

Under frame of WDM3D for WDM2G / WDS6ADT for WDS6G locomotive shall be used. The tenderer shall ensure proper mounting and mechanical integration of all the major equipment supplied. The general arrangement and equipment layout drawing of all the major equipment indicating integration with the bogie shall be submitted by the tenderer for RDSO approval.

The locomotive shall be arranged and equipped so that the short hood or cab end is considered the front.

Items that are to be retained from WDM3D for WDM2G / WDS6ADT for WDS6G locomotive and within scope of IR are discussed below. These are not in the scope of new supply by the successful tenderer, who shall however, have to submit engineering drawings for any modifications required for purpose of integration.

3.2 Underframe *(IR's Scope)*

New under frame WDM3D for WDM2G / WDS6ADT for WDS6G locomotive shall be used. Floor frame assembly drawing of ~~WDM3D~~ locomotive is placed at annexure-I A & I B.

3.3 Bogie (IR's Scope)

~~New bogies of WDM3D locomotive (Two 3-axle bogies of the Trimount type fully equalized) shall be used. Two stage suspension equalizer less bogie will be used. In addition to the swivel bearing about which bogie swings, there are two pads, one on each side; the three thus form a three point support to carry the load on each bogie. The lateral spacing of pads, affords stability on a curve and their frictional resistance prevents nosing at high speeds. The suspension is on four groups of springs, two outer and two inner helical coils each, the inner coils working in conjunction with friction snubbers. The axle boxes are of roller bearing type. Dimensions and floor frame assembly drawing of existing WDM3D locomotive is attached at annexure-I.~~

~~To increase the loco tractive effort, high adhesion bogies are being used.~~

For WDM2G new bogies of WDM3D locomotive (Two 3-axle bogies of the Tetra-mount type fully equalized) shall be used. There are four point support to carry the load on each bogie. Two stage suspension equalizer less bogie will be used. To increase the loco tractive effort, high adhesion bogies are being used.

For WDS6G new trimount ATHS bogies with A1A arrangement shall be used. In addition to the swivel bearing about which bogie swings, there are two pads, one on each side; the three thus form a three point support to carry the load on each bogie. The lateral spacing of pads, affords stability on a curve and their frictional resistance prevents nosing at high speeds. The suspension is on four groups of springs, two outer and two inner helical coils each, the inner coils working in conjunction with friction snubbers. The axle boxes are of roller bearing type.

3.4 Fuel tank *(IR's Scope)*

3.4.1 Fuel tank shall be structurally intact and free of defects; with the same capacity and size as in the existing WDM3D for WDM2G / WDS6ADT for WDS6G locos. The successful tenderer shall indicate the fuel suction arrangement from the tank.

3.5 Air Brake System *(IR's Scope)*

~~The existing Air Brake system i.e. IRAB1 shall be retained. Any modifications needed shall be indicated by the tenderer. Brake system details can be obtained from RDSO. All air piping shall~~

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~~be procured by IR, however the tenderer shall indicate the layout of the piping required to suit the location of compressor etc.~~

The existing panel mounted Air Brake System i.e. IRAB1 as per RDSO specification no. MP-0.01.00.19 (Rev-01), June'2010 and drawing No. SKDP-3100 Alt-11 shall be retained along with all the features of existing brake system. Any modifications needed shall be indicated by the tenderer. Brake system details can be obtained from RDSO. All air piping shall be procured by IR, however the tenderer shall indicate the layout of the piping required to suit the location of compressor etc. The location and orientation of brake valves (A-9, SA-9) on control stand shall be in compliance to UIC-541-03 OR. The location and orientation of D-1 emergency brake valve shall be according to provision in existing ALCO series locos Viz. WDG3A.WDM3A, WDM3D.

3.5.1 Air dryer of approved make confirming to specification no. MP.0.01.00.06 (latesr revision), shall be provided.

3.5.2 Dual tone horn shall be provided as per RDSO specification no. MP.0.99.00.04 Nov 1990.

3.5.3 Brake Block either 'L' type to RDSO specification no. MP.0.01.00.04(latest revision) or high friction composition brake block to RDSO specification no. MP.0.01.00-10 (latest revision) of RDSO approved make shall be used depending upon the design of the brake rigging.

3.5.4 Hand Brake shall be provided as per RDSO drg. no. SKDP-3947.

The supplier shall submit details of brake system covering brake schematic diagram, working principal, brake power diagram, calculation for EBD, number, dimension and type of brake blocks and literature on brake equipments proposed along with offer and get the brake system approved from RDSO before manufacture of the prototype

3.6 Vigilance Control Device *(IR's Scope)*

~~This would be as per RDSO specification No. MP.0.34.00.04 (latest revision). Successful tenderer should integrate the existing VCD with the offered locomotive control system.~~

VCD shall be part of loco microprocessor system. However, its functionality shall be as per RDSO specification No. MP.0.34.00.04 (latest revision). Successful tenderer should integrate the VCD features with the offered locomotive control system.

3.7 Battery System (IR's Scope)

3.7.1 Existing batteries of the locomotive shall be supplied. The batteries are flooded lead acid batteries of 500AH capacity. Detailed specification can be seen at RDSO.

3.8 Traction Motor (IR Scope)

Existing traction motors e.g., TM4907 etc. used in WDM2 type ALCo locomotives shall be used. Performance characteristics of TM4907 traction motor is attached at annexure-III.

The successful tenderer shall have to design the control system to suit the motor characteristics. One Traction motor will be provided by IR for testing and obtaining the real characteristics of motor to design the control system.

Firm will submit indemnity bond for the material issued by IR.

3.9 Painting and Styling

All doors and cover plates guarding high voltage equipment shall be marked "Danger High Voltage" or "Danger". Style / Sandblasting and Paint Shall be in accordance with RDSO drawing. PV painting shall be done.

Exterior of locomotive to be basic painted to RDSO specifications. (Standard 3 colors). Cab interior is painted with basic enamel per RDSO specification. Control stand and interior of the short hood, long hood and components shall be painted per RDSO specification. Exterior car body surfaces shall be painted with black polyurethane enamel.

Stencil (stick on type) to be applied to the paint, including the sides of the hood and numbers on the cab. All decals shall be applied per RDSO paint scheme.

DRAFT

Chapter 4

4.0 Description of items in new scope of supply and to be procured from the tenderer.

4.1 General: All electrical machines and control equipment shall generally conform to relevant IEC publications and shall be tested as per RDSO approved test programme. The temperature rise limits of the IEC publications shall be reduced by 20°C for traction motor and by 30°C for other machines to account for higher ambient temperatures in India.

4.2 The tenderer shall acquaint itself regarding the locomotive undertaken for conversion. Apart from the new supply of items, the tenderer shall make itself aware of the existing systems of the locomotive and shall provide the layout/ integration drawings to ensure proper integration of the equipment offered on the existing loco platform.

4.3 The following items under this chapter are in the scope of new supply and shall be purchased from the successful tenderer through this specification. The tenderers need to quote for the following items for successful manufacture of the proposed locomotive. Diesel engine, alternator, chopper/rectifier, radiator fan, fuel pump motor, starter motor and lube oil / water tank along with the cooling/lube oil system shall be integrated in a single assembly frame of each GenSet which is ready to be used with DC output voltage.

4.4 Diesel Engine *(new scope of supply)*

Engine shall be Cummins QSK-19, N-Gen II type with In-Line, 4-Cycle, 6-Cylinders. Its rated power shall be upto 800 BHP or equivalent. ~~Its displacement shall be 1159 cu. In. 19 Litres. Aspiration shall be turbocharged with Air-to-Air Charge Air Cooled. The Engine shall be designed and certified as atleast EPA Tier II Off-Road compliant with Full Authority Electronic Controls.~~

~~The engine shall have:~~

- ~~Total Engine protection alarm and shutdown functionality for oil and water pressures, temperatures and levels.~~
- ~~All fuel, oil and water hoses and connections certified to -20ºC.~~
- ~~All gasket materials certified to -20ºC.~~

~~Following information shall be provided by the supplier:~~

- ~~Specific fuel consumption at various throttle positions under UIC conditions indicating tolerance band, output and engine speed by using fuel having lower calorific value of 10030 Kcal/kg.~~
- ~~Fuel oil consumption at low idle and normal idle conditions and Lube oil consumption at rated output as percentage of fuel oil consumption~~
- ~~Derating calculations for site conditions of 50 °C ambient temperature and 160 m altitude indicating limiting factor~~

- The diesel engine capable of producing not less than 800hp (continuous) under standard conditions (as per clause 4.2.1 of UIC 623-2 OR, it is 100 kPa, 25ºC and 30% Rh) and shall be provided with suitable speed control exciter control.
- The engine shall have 6-cylinder (in-line) turbocharged with air-to-air charge air-cooled or equivalent suitable for shunting loco application. The engine shall be a fuel efficient diesel engine
- The engine shall meet the emission standard of emission standard EPA Tier II or equivalent standard with Full Authority Electronic Controls. However, the tenderer shall clearly spell out the emission standards of the engine being offered.
- The engines shall be fuel efficient and shall be provided with idle limiting equipment i.e. it shall shuts down and restart automatically after specified time.
- The design of engine shall be modular type i.e. it shall cover lesser space.
- The noise level due to engine shall be within the limit and shall be as per clause 2.10 of UIC 651 OR.
- The design shall be such that maintenance shall be easy & quick.

DRAFT

- The engine shall be provided with the following safety protection
  - Engine protection against low lube oil level, low lube oil pressure, high lube oil temperature, low cooling water level, high water temperature, over speed etc.
  - All the hoses & gaskets fitted with the engine shall be suitable for -20 degree centigrade of ambient.
  - Any other safety device/ protection shall be proposed by OEM.
- The supplier shall submit rate of fuel consumption in kg/hr and SFC (in g/bhp-hr and g/kW-hr) under no-load & various load conditions with respect to rpm, torque & bhp indicating Tolerance band at rated output under UIC conditions as indicated in UIC-623-OR.
- The supplier shall submit specific fuel consumption at low idle and normal conditions and lube oil consumption at rated output as percentage of fuel oil consumption.
- The supplier shall submit ISO fuel maps for entire range of operation of the engine.
- The supplier shall submit the uration calculation for site condition at 500C and at the altitude of 160m indicating limiting factor
- The OEM shall submit the details of power absorbed by the individual accessories essential for the working of the engine.
- The diesel engine shall work satisfactorily with fuel oil to Indian Standard Specification No. 1460 (2005).
- The Filters for engine air intake shall be provided with restriction indicator to ensure satisfactory performance under dusty environment.
- Suitable provision for lube oil drain arrangement from engine sump easily shall be provided to avoid oil spillage.
- The engine shall be provided with suitable thermal insulation lagging in the exhaust piping from turbocharger outlet till the silencer inlet.
- The supplier shall furnish a copy of 100 hours Type Testing report of the engine conforming to UIC 623-2 OR in support of their claim regarding performance, reliability & specific fuel consumption. In case, the offered engine is to be used first time in Indian Railways, the 100 hours type testing shall have to be carried out in accordance with UIC 623-2-OR in the presence of RDSO's authorized representative at OEM's works and the scheme for 100hrs type testing shall be finalised by RDSO & supplier jointly and mutually agreed.
- For all the remaining engines, other than the first engine offered for 100 hours type testing, the Routine test report shall be required to be submitted alongwith respective engines at the time of supply.

The supplier shall indicate brake specific fuel consumption of the diesel engine with tolerance band at rated output under standard UIC conditions indicated in UIC-623-OR.

4.4.1 The supplier shall also give ISO fuel maps for entire range of operation of the engine.

4.5 Engine Cooling and Lubrication Systems

4.5.1 Engine Lubrication System *(new scope of supply)*

4.5.1.1. The Genset shall contain a system that automatically replenishes engine oil, utilizing an oil supply tank that holds 14 gallons of oil.

4.5.1.2. Two sight glasses shall be mounted on the left side of the tank to monitor oil level in the tank.

4.5.1.3. Each Genset shall contain a lube oil system suitable for a minimum of 92 days between services – with oil sampling.

4.5.2 Engine Cooling System *(new scope of supply)*

4.5.2.1 New mechanically bonded radiator(s) with coolant sensor of suitable capacity shall be installed.

DRAFT

4.5.2.2 The radiator fan shall be driven by a three phase AC motor. The motor shall be powered by the main alternator output of each Genset. The cooling system performance shall match with cooling requirement of the diesel engine. This shall be ensured by the tenderer.

4.6 Transmission System *(new scope of supply)*

The alternator excitation shall be controlled to control the output current & voltage. Protection and Indication system for output current & voltage shall be provided. Similarly traction motor current shall be monitored with indications and protection for over current, over temperature and open circuit conditions shall be provided.

Power from one engine to the next shall be shared – after the maximum power of the first engine is consumed and the second is started then the power of the two are equally shared until maximum of both is consumed, then afterwards third engine comes on line and the power is "shared" by all three equally.

When the power is required, time lag shall be less than 10 seconds for another engine to start. In case the power requirement is no longer then the second engine stays on line for 10 minutes, so that in case the demand is present again the power is immediately available.

4.7 Alternator *(new scope of supply)*

Alternator(s) shall be as part of the diesel generator package and shall be rated at 3-phase, 240 VAC, 60 Hz @ ~~1800~~ 2100 rpm. This shall maintain a 4 Volts/Hz ratio through the RPM Schedule (1200 to 2000 RPM). Power rating shall be 600 kW. Insulation system of the alternator shall be class 'H' or above.

4.8 DC Chopper *(new scope of supply)*

Chopper of suitable rating and design shall be employed to feed DC power supply to traction motors. Details of the chopper shall be furnished by the tenderer.

4.9 Auxiliary Power Systems *(new scope of supply)*

An AC inverter shall be used for Air Conditioning power supply. This shall be a 74 VDC to 110 VAC single phase inverter.

4.10 Details of Electrical System *(new scope of supply)*

- All wiring and cabling shall be with EXANE insulated AAR approved cabling
- Electrical switch gear shall be motorized switch gear.
- Rubber style cable cleating shall be applied.

4.11 Air Compressor *(scope of new supply)*

~~A proven, variable speed 240 VAC 3-Phase electric motor driven rotary screw type air compressor shall be used. Short and open circuit protection shall be provided for the air compressor. Air compressor MU synchronization shall be provided. Air compressor shall be set to load at 130 PSI and unload at 140 PSI. Air compressor shall provide a minimum displacement of 140 CFM at maximum operating rpm. Compressor shall run independent of the engines i.e. it shall work if either of the engines or all are working. Details of the compressor to be submitted to RDSO and clearance taken for fitment.~~

A proven, variable speed 240 VAC 3 phase electric motor driven air compressor (positive displacement, reciprocating type) shall be used. Short and open circuit protection shall be provided for the air compressor. Air compressor MU synchronization shall be provided. Air compressor shall be set to cut in at 130PSI and cut out at 140PSI. Air compressor shall provide minimum free air delivery (FAD) of 2000 lpm at maximum operating rpm of motor. 02 compressors of minimum FAD 1000 lpm each can also be used in lieu of a single minimum FAD 2000 lpm compressor. Compressor shall run independent of the engines i.e. it shall work if either of the engines or all are working. Details of the compressor to be submitted to RDSO and

DRAFT

clearance taken for fitment. Suitable inter-coolers and after coolers shall be provided to cool the compressed air delivered by the compressor.

4.12 Dynamic Brake equipment *(scope of new supply) For WDM2G*

4.12.1 Grid Current Control type Dynamic Brake system shall be used. The tenderer shall submit the dynamic brake characteristics that shall not be inferior to the existing curve placed at annexure-V. The firm shall provide detailed layout drawings of the equipment to be installed and indicate the wiring requirements.

4.12.2 Extended Range Dynamic Brake shall be provided. Dynamic braking will be maintained in the event of any emergency application.

4.12.3 Self load operation shall be provided.

4.13 Control Systems *(scope of new supply)*

Microprocessor based electronic control system shall provide all propulsion, accessory equipment and low voltage controls. Display panel shall provide for monitoring of real time events, storing fault & run time data and performing self tests.

Control system modules shall be suitable for a scalable system with inter-changeable modules. Custom configurations for most of the important parameters shall be possible based on requirements. All boards shall be multi-layered utilizing EMI shielding. The control software shall be in-system programmable, allowing for easy field upgrades and maintenance.

The CPU board shall be a 32-bit processor with at least 150 MHz clock speed and 64 Megs of Flash memory for data storage. This shall be an Industrial Controller designed to AAR locomotive standards.

Internal Controller Area Network (CAN) Bus Technology shall be adopted which shall be designed to operate in electrically noisy environments with a high level of data integrity, highly fault tolerant, with powerful error detection and handling designed in.

Input and output boards shall preferably be designed to have a total capacity expandable up to 120 digital inputs and 60 digital outputs. Digital I/O can be configured for either 24 or 74 VDC.

Electronic sensors shall be monitored including voltage, current, pressure, and temperature. There shall be two inputs available on each Input/Output board, expanding the analog interfacing capabilities by up to 10 additional sensors.

Control Module shall be manufactured for the locomotive industrial environment using the latest technology and include a two slot box and one multifunction board. There shall be a provision so that a second Input/Output board can be installed depending on application needs. This shall allow for a scalable system with inter-changeable modules. All boards shall be multi-layer utilizing EMI shielding. Operating firmware shall be in-system programmable, allowing for easy field upgrades and maintenance.

The microprocessor based control system with operator interface panel shall be used that is designed to maximize the adhesion of the traction motors & monitor as many practical system parameters & log fault data as follows:

4.13.1 The Microprocessor will control the following contactor and relay pick-up and drop-out signals:

Power Contactors, Reversing Transfer Switches, Air Compressor Loading Relays and Contactors, Air Compressor Drive Motor Contactors, Ground Relay, Alarm Relay, Load Shedding Contactor, Traction Motor Cut out Relay, Genset Starting and Shutdown control, and Equipment Blower Contactor.

4.13.2 The Microprocessor shall monitor and have available for display with a laptop, a serial connection to an onboard computer and an Operator Interface panel and will display the following functions:

DRAFT

Generator Voltage and Current of each Gen Set, All Traction Motor Currents, All Traction Motor Volts, Throttle Notch, Contactor and Relay Position, Air Compressor Cycle, Battery Charging Voltage and Current, Generator Set Fault and Warning Status, Trainline Status, Total Horsepower, Locomotive Speed, Main Reservoir Pressure, Reversing Switch Position, Dynamic Braking, Sanding Status, and Engine RPM

4.13.3 The Microprocessor will control the following systems:

Wheel Slip Detection and Correction including Auto Sanding, Traction Power Regulation, Air Compressor Functions, and Auto Start/Stop Functionality as per AAR S-5502, Throttle Load Rate Control, Engine Over Load Protection, Locomotive Over Speed Control & Indicator Light Control.

4.13.4 The Microprocessor will log the following fault conditions:

Ground Fault, Overspeed, Engine RPM, Generator Set Fault and Warning, Over and/or Under Current and Voltage (Gen Set, Traction Motor, Air Compressor Motor, Equipment Blower, Low Voltage Power Supply and DC Chopper), Open Circuit (Traction Motor Blower, Air Compressor Motor, etc.), Contactor or Relay Fault, Undesired Horsepower Output, Battery Charging Failure, and Air System Failure.

Fault & Diagnostic system shall have following features:

- All records shall be time stamped
- All measurements shall be displayed in Metric or Imperial
- Shall include trip & long term statistics logs
- Shall include minimum 120 second diagnostic log (0.1 second resolution)
- Shall include fault with minimum 2 seconds of data before & 1 second after event (0.1 second resolution)

4.13.5 The Microprocessor will “Snapshot” the following parameters with a fault log:

Traction Horsepower, Throttle Notch, Speed, Traction Motor Current, Traction Motor Voltage, Power Contactor Status, Transfer Switch Status, Generator Set Status, Generator Current, Air Compressor Status, Battery Charging Current, Battery Charging Voltage, Train line Status, Sanding Status, and Air System Status.

4.13.6 The Microprocessor will store following types of performance data:

Throttle Notch Percentage, Miles per Throttle Notch, Horsepower per Throttle Notch, and Auto Start/Stop Time Periods.

4.13.7 Following Operator-Initiated Self Test features shall be provided:

- Relay & Contactor Test
- Engine Cooling Fan Test
- Self-Load & Load-Box Test
- Load Meter Test

4.13.8 Automatic ground relay reset shall be provided with ground relay lockout and fault logging.

4.13.9 Power supply board shall have following features:

- Powered by the 74 VDC locomotive battery, but will operate over a wide range of input voltages from 50 VDC to 95 VDC.
- Locomotive battery charging voltage regulation shall be included.
- Integrated Digital SCR/SE control shall be provided.
- Load Meter Drive – Shall use the average of all cut-in traction motor currents.

DRAFT

- One 0-100 VDC analog voltage output– Can be used to supply voltage references for such applications as slow speed control.
- Two 0-100 VDC analog voltage inputs – Shall be made available to measure signals such as battery voltage, DB reference voltage, Hump Control reference voltage and load regulator wiper voltage.
- External Serial EEPROM interface shall be available to store locomotive and system long term statistics.

4.13.10 Optional Features *(scope of new supply) through microprocessor control:*

Following optional features may also be provided in the offered design. These features must be priced separately in the offer:

- Air Compressor Control
- Engine Governor Throttle Control
- Automatic Ground Fault Detection & Smart Reset
- Pre & Post Engine Lubrication
- Integrated Vigilance Package
- Traction Motor Cutout from display eliminating MCO switch
- Integrated Idle Limiting Control
- Fan Control – To monitor water temperature and activate the cooling fans at specified temperatures, while cycling through the fans to share fan operation.
- Locomotive statistics logs/records - These statistics may then be used to compare locomotive maintenance costs against locomotive working time.
- Traction Motor Protection – To provide protection from running traction motors in short term ratings for too long, causing traction motor reliability issues.

4.13.11Driver's cab

The existing driver's cab shall be replaced. The full width driver cab shall feature a clean, safe interior design with consol type control arrangement or alternative AAR type control stand. The cab shall be fully insulated throughout to achieve lowest possible cab interior noise level less than 85 dB. A work station for driver shall be furnished on the left hand side. Two fully adjustable, lumber support driver seat shall be provided with one additional wall mounted seat for inspector. The layout of cab shall maximise free floor space by ergonomically arranged equipments and free from sharp edge and safety hazards. The cab flooring should be slip-free and non inflammable. The cab door is provided with sealing arrangement against noise, fumes & dust. The drivers cab as per the modified design to be supplied by the successful tenderer. The tenderer shall also submit cab drawing along with mounting details ~~mounting drawings~~ to execute fitment of the same. The optional feature Toilet may be provided adjacent to cab.

4.13.12 Superstructure

Existing hoods shall be replaced. The hood over engine as per the modified design to be supplied by the successful tenderer. The tenderer shall also submit ~~mounting drawings~~ superstructure drawing along with mounting details to execute fitment of the same.

4.13.13 Control console (IR's Scope)

Existing control console shall be replaced. The control console as per the modified design to be supplied by the successful tenderer. The tenderer shall also submit mounting drawings to execute fitment of the same. *Gauges/ meters specific to the offered design shall be indicated by the tenderer and would be in the scope of supply of the tenderer.*

DRAFT

Chapter 5

5.1 Testing & inspection

5.1.1 Type and routine tests on the equipment related with microprocessor based controls and traction converter/chopper system offered shall generally be conducted in accordance with IEC-60571, IEC-61287 and other relevant IEC standards. However, if the tenderer proposes a different test scheme, the same can be examined by RDSO on provision of alternative test procedures submitted by the tenderer.

5.1.2 The supplier shall submit detailed type and routine test programs to RDSO for its approval. RDSO may also decide to carry out some special tests on the equipment, which are not covered by relevant IEC specifications. Tests shall be carried out as per mutually agreed test program and the total cost shall be borne by the manufacturer.

5.1.3 Type test/inspection of the complete equipment shall be done by the RDSO/Indian Railways representative(s) at the firm's premises before despatch. All the facilities shall be made available at the firm's premises for carrying out the prototype test.

5.1.4 A final validation test shall be conducted at Indian Railways unit on the load box by Indian Railways, in which all the performance requirements which can be determined in static condition shall be established by the manufacturer, particularly the power requirement. Tenderer shall provide validation test plan along with equipments, software programme. All test during validation test will be carried out under guidance of firm engineers and engineers of IR also be trained by them.

5.2 Field trials: One prototype locomotive shall be subjected to field trials on Indian Railways for at least three months as per test scheme provided by firm. The manufacturer shall depute a team of engineers for commissioning, testing and field trials of the locomotive and its equipment in service. The manufacturer shall associate in the field trials jointly with Indian Railways. The manufacturer shall ensure availability of typical tools & spare parts in adequate quantity for field trials, to be done as part of commissioning.

5.2.1 All the modifications required due to defects noticed or design improvements found necessary as a result of the field test / trials shall be carried out by the tenderer in the least possible time. Total cost of such modifications/design changes shall be borne by the manufacturer.

5.3 Documentation

5.3.1 All the information which would be required to evaluate the suitability of the offer vis-à-vis this specification shall be submitted along with the offer. Following documents shall invariably be submitted by the tenderer along with the offer for evaluation:

(a) Functional description of the complete system, including salient features and advantages of the offered system

(b) Clause by clause compliance with the specification.

(c) Details of technical support and training offered.

(d) All characteristics curves, including the proposed notch-wise TE Vs Speed, fuel efficiency, efficiency and ventilation characteristics of the major equipment offered, parasitic load of the auxiliaries used in the system, BE Vs Speed, basic design data like ratings, power circuit diagram and temperature capability, envelope and mounting drawings etc. shall be submitted with the offer.

5.3.2 Following documents shall be submitted by the successful tenderer, in hard and soft copies, before commissioning of the equipment on loco.

(a) Technical documentation explaining the complete system including characteristic curves and efficiency, diagnostics and protection circuits etc.

(b) Locomotive control circuit schematics.

DRAFT

(c) Lay out and mounting drawings of all the equipment offered

(d) Drawings of each sub-system with interface details.

(e) Cooling system details.

(f) Details of enclosures provided.

(g) Details of lubricants.

(h) Procedure for user settable parameter alteration, fault data downloading and analysis etc.

(i) Maintenance, troubleshooting and operating manuals with detailed information for all the equipment offered in soft (CD or DVD) and hard copies.

(j) Renewal parts manual in soft (CD or DVD) and hard copies.

(k) Recommended list of spares for 3 years with price.

(l) List of special tools, jigs and fixtures needed for testing, commissioning, maintenance and repair.

(m) Modifications needed in the existing locomotives to adopt the offered system.

Irrespective of the details brought out here, all information and documentation which are essential for operation and maintenance of the locomotive with the equipment supplied shall be submitted on request of Indian Railways.

5.4 Quality Assurance

The successful tenderer shall also be required to submit a detailed Quality Assurance Plan (QAP) certified to AAR M-1003 standard for approval by Indian Railways before the same is adopted. Documentation of this certification and a description of their product quality assurance system shall be provided, including a description of:

- Quality Assurance Overview
- Quality Procedural Documentation
- Purchased Material Quality
- Manufacturing Quality
- Test Methods and Procedures
- Customer Participation

5.5 Warranty

The complete system with controls shall be warranted for satisfactory and trouble free operation in conformity with the standard IRS conditions. All aspects of workmanship and design shall be covered by this warranty. The supplier shall immediately provide arrangement for rectification of failures reported under warranty.

Warranty period of any equipment of the system may be extended as per mutual agreement between Indian Railways/RDSO and supplier if the equipment has undergone major design modifications during the warranty period.

5.6 Failures during warranty period under maintenance contract

5.6.1 In case of any failures, the details of failure and action taken to arrest re-occurrence of similar failure in future with failure analysis report etc. is to be submitted to Indian Railways/RDSO.

5.6.2 In case of repeated failures, necessary changes in design on the units put in service or in production line are to be made by the manufacturer. Investigation tests, if considered necessary, are to be arranged/conducted by the manufacturer.

5.7 Annual maintenance contract

The annual maintenance contract agreement is required to be entered between supplier of multi Genset equipment and Indian Railway's for use and operation by the Zonal Railways at Headquarter/ Divisional level under the supervision of Zonal Railways. The above contract shall cover the comprehensive maintenance requirement of all the supplied equipment fitted on 2400BHP(WDM2G) / 1600BHP(WDS6G) multi Genset locomotives.

DRAFT

The contract shall be comprehensive in nature wherein preventive as well as Breakdown Maintenance of all the supplied equipment is to be attended including the supply of spares, tools, consumables, technical expertise and manpower.

The maintenance and support by the contractor shall consist of 4, "three monthly preventive checks of all the supplied equipment for trouble free services of the locomotives as prescribed by the supplier, including attention to the locomotives when they touch the shed at 25 days interval. It shall include all extra and out of course attentions including breakdown, if any required, to ensure trouble free operation of the locomotive.

The contractor shall ensure that downtime on account of all maintenance (Preventive and breakdown) of the equipment does not exceed an amount equivalent to 10% of total loco hours for the locomotives covered in the contract. Downtime accountal shall be carried out every month and the contractor has to ensure not less than 90% availability on all the supplied equipment account.

In addition, at no time, more than 5% locomotives will be under breakdown repair on supplied equipment account i.e. the number of locos under breakdown at 0.0 hrs daily shall not exceed 5% of the locomotive under contract.

Based upon the experience gained by the contractor in the first year of the contract, it should be possible to improve upon the above referred levels of availability and downtime. The tenderer should indicate the same in his quotation/tender.

The locomotives going out of the manufacturers' warranty for all the supplied equipment shall only be included under the annual maintenance contract. The firm shall give warranty of all the supplied equipment fitted in multi Genset locomotive for trouble free service for 24 months from the date of commissioning or 30 months from supply of all the equipment by the firm whichever is earlier.

The maintenance contract shall be valid for two years from the date of expiry of warranty of the Locomotive. All the repairs/three months schedule due within the date of expiry of contract shall, however be completed by firm & the contract will be treated as valid till such completions of the work. Any extension of the contract shall be for a minimum period of one year of multiple thereof.

5.8 Marking and packing

5.8.1 Each equipment shall bear for identification Indian Railway's order number, batch/lot number, serial number, type, year of manufacture, manufacturer's name as well as important nominal and short time ratings.

5.8.2 All equipment of the complete system shall be suitably packed in strong water proof boxes to prevent any damage during transit and handling.

5.9 Other details

5.9.1 The manufacturing/assembly drawings shall exhibit clearly the material specification, welding symbols, manufacturing tolerances and other details that are necessary for manufacture of the components. Complete Harness diagram with wire cutting chart and details of crimping tools equivalent to metric size which is being used by IR. Tenderer should provide concise operator and service manual and detail part list with description of locomotive.

5.9.2 The set of drawings shall be sent for RDSO approval before undertaking manufacture of the prototype Locomotive.

5.10 Infringement of patent rights

Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, components used in design, development and manufacturing of complete system and any other factor, which may cause such dispute. The responsibility to settle any issue lies with the manufacturer.

DRAFT

Floor frame assembly drawing of WDM3D refer to DLW drawing No. 11531137.

* DLW has developed Floor frame assembly drawing no. 11536494 for WDM2G.
* Two WDM2G locomotive no. 80000 & 80001 has been manufactured on above platform and running in service.

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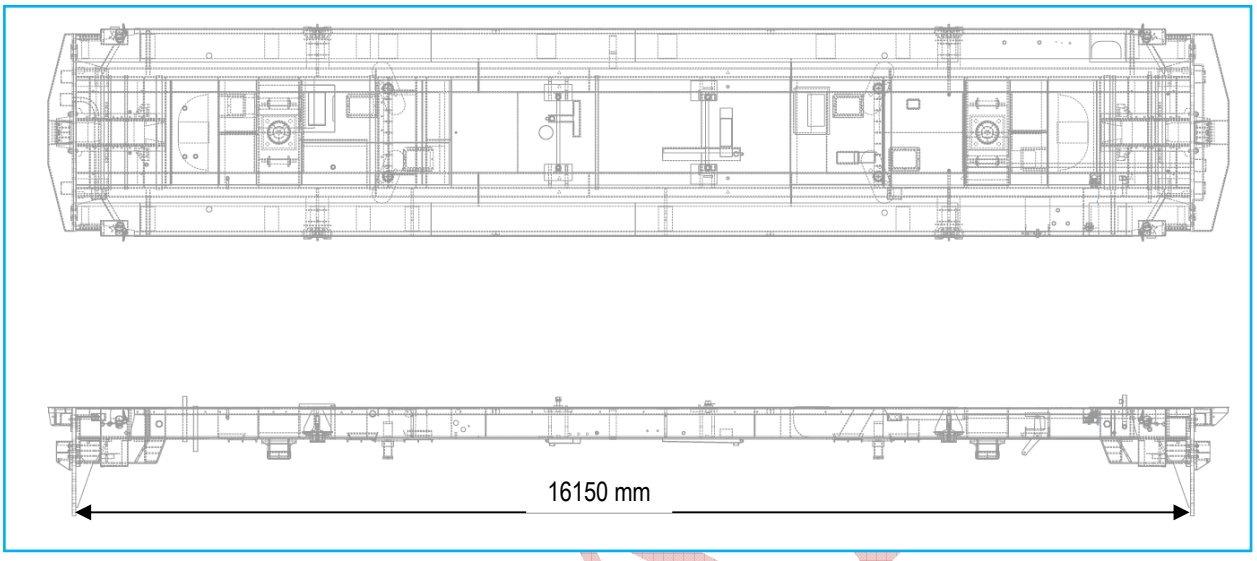
Annexure – I B

Floor frame assembly of WDS6ADT (ref. DLW drg. no.11534783)



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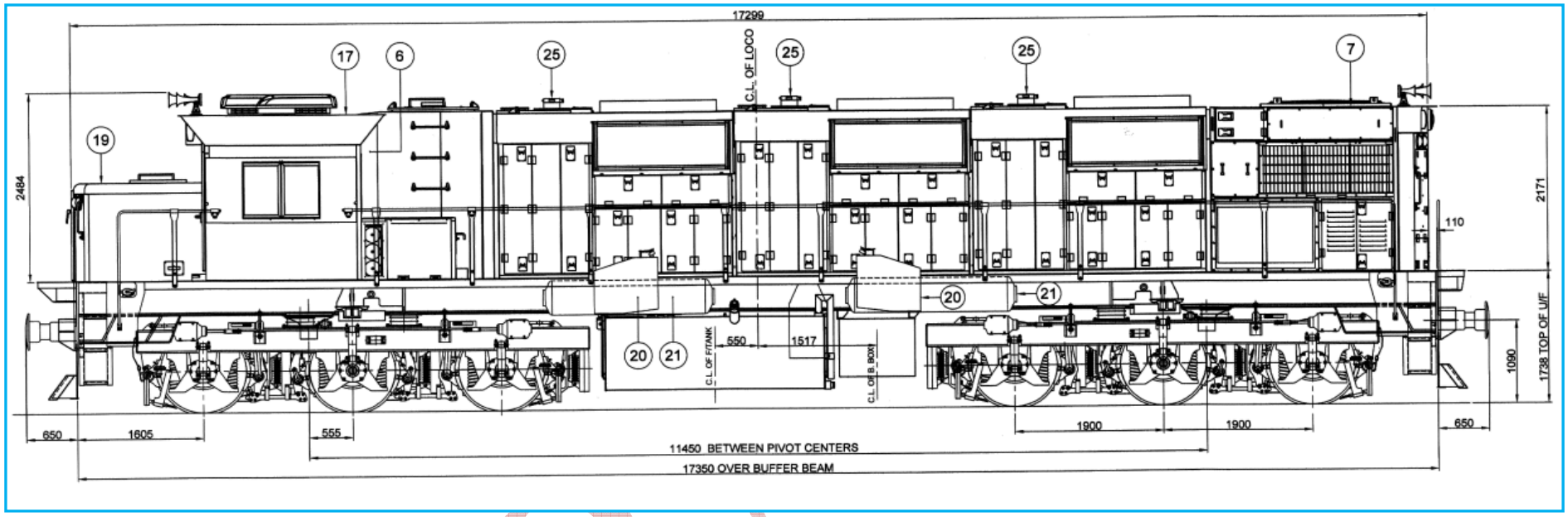
Annexure – II A

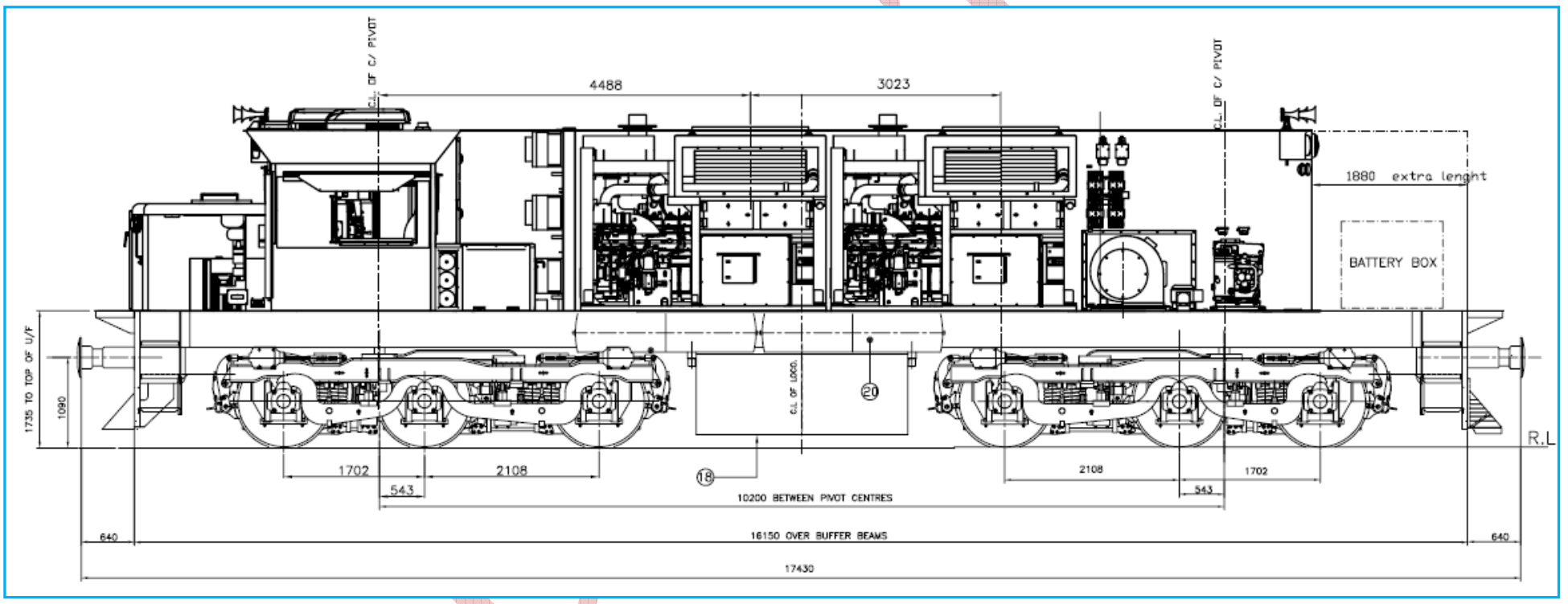


REF. NO.	I.R. PART NO.	DESCRIPTION	NO./ LOCO
13		74V BATTERY BOX	1
12		AIR BRAKE RACK	1
11		INERTIAL FILTER	1
10		FILTER MAIN ELECTRIC CABINET	1
9		ELECTRIC PARKING BRAKE	1
8		DYNAMIC BRAKING UNIT	1
7		DB COMPARTMENT	1
6		MEC EQUIPPED ASSLY.	1
5		AIR COMPRESSOR	1
4		TRACTION MOTOR BLOWER	1
3		LOW VOLTAGE POWER SUPPLY	1
2		EQUIPPED CHOPPER TOWER ASSLY.	1
1		N-GEN II F, 800 HP.	3

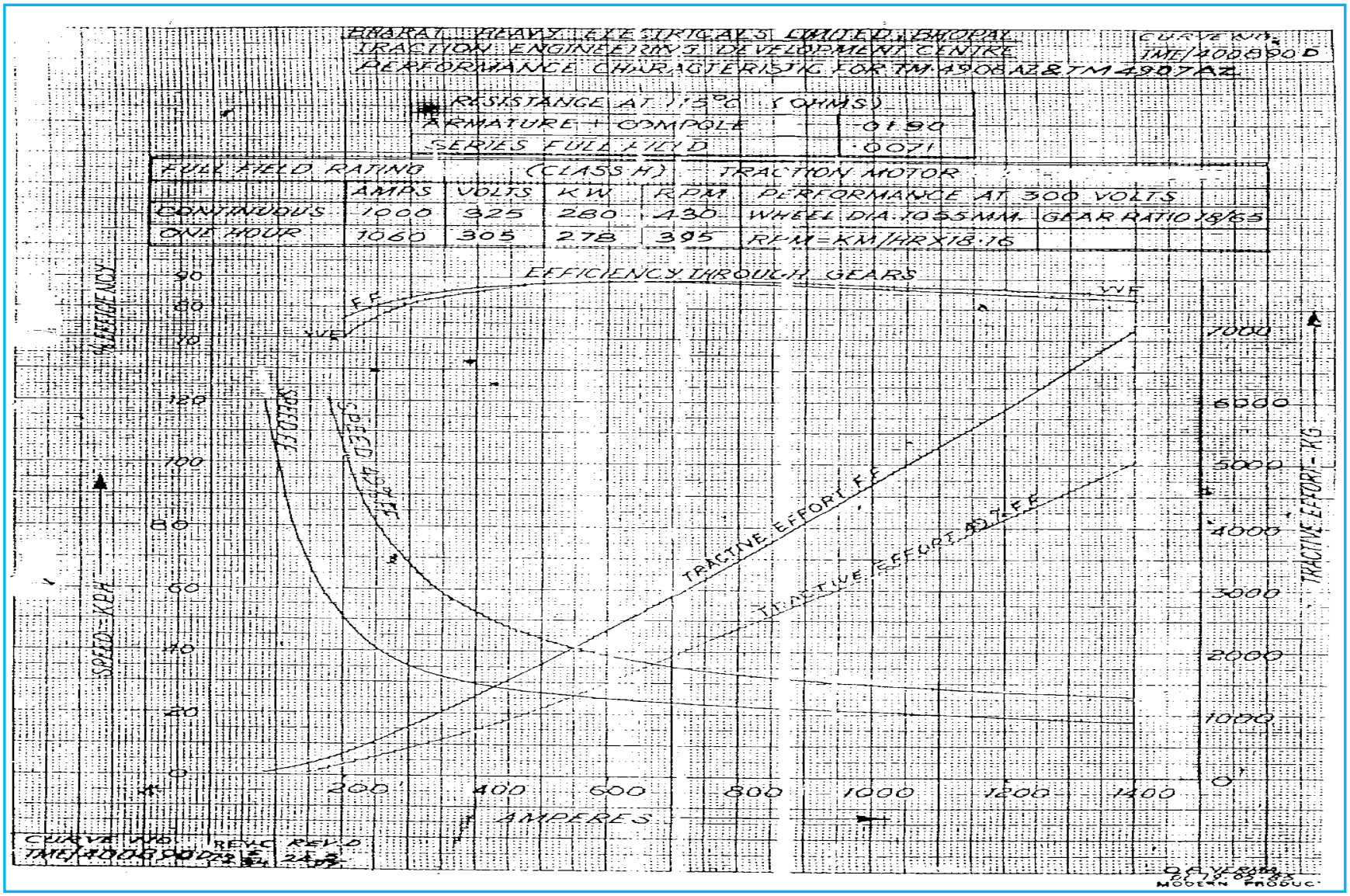
26		CONTROL CONSOLE	2
25		EXHAUST EXTENSION	3
24		HEAD LIGHT	2
23		HORN	2
22		AIR DRYER	1
21		MAIN RESERVIOR	2
20		SAND BOX	4
19		SHORT HOOD	1
18		FUEL TANK	1
17		CAB	1
16		BOGIE	2
15		HVAC UNIT	1
14		24V BATTERY BOX	1

Annexure – II B

Tentative General Arrengement

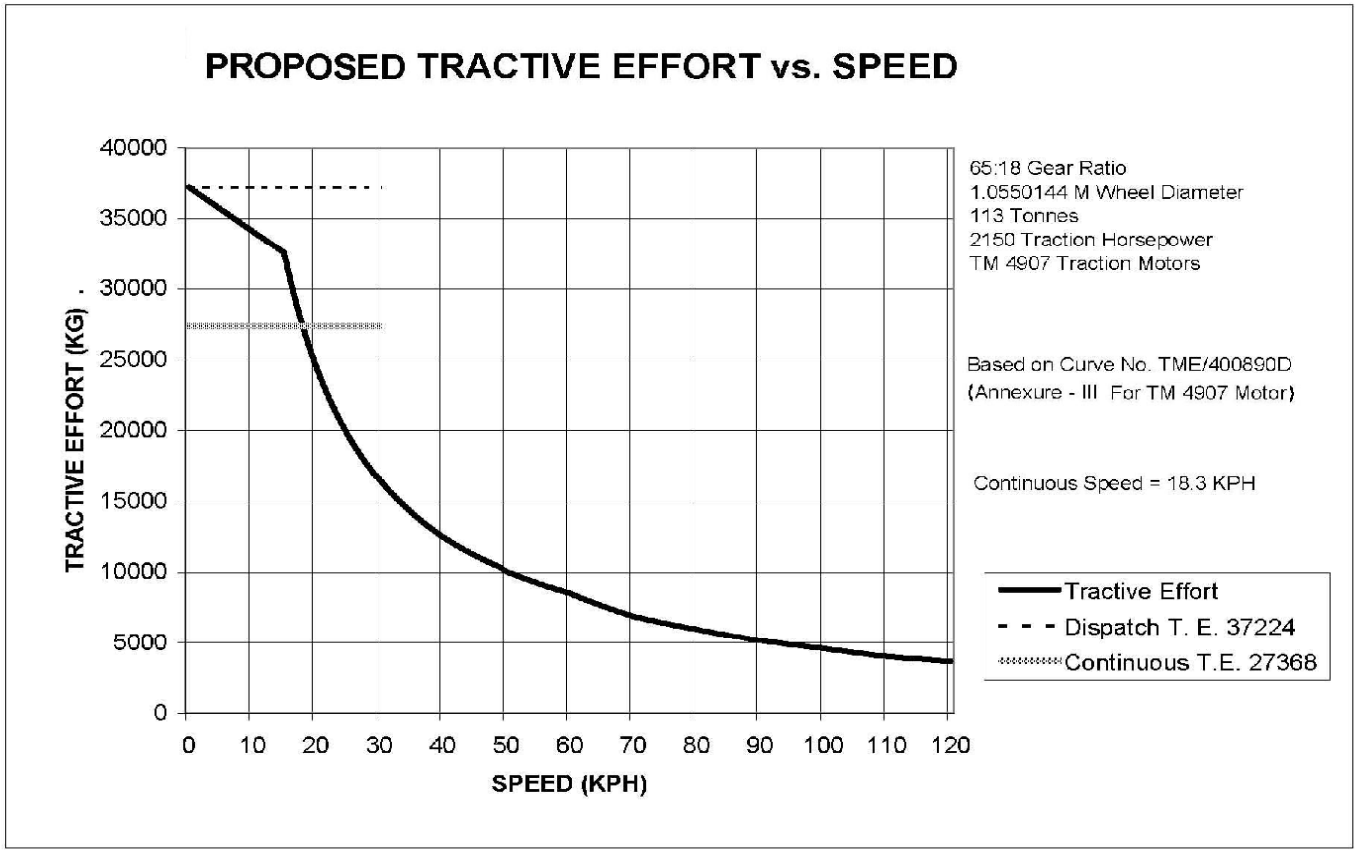


Annexure – III



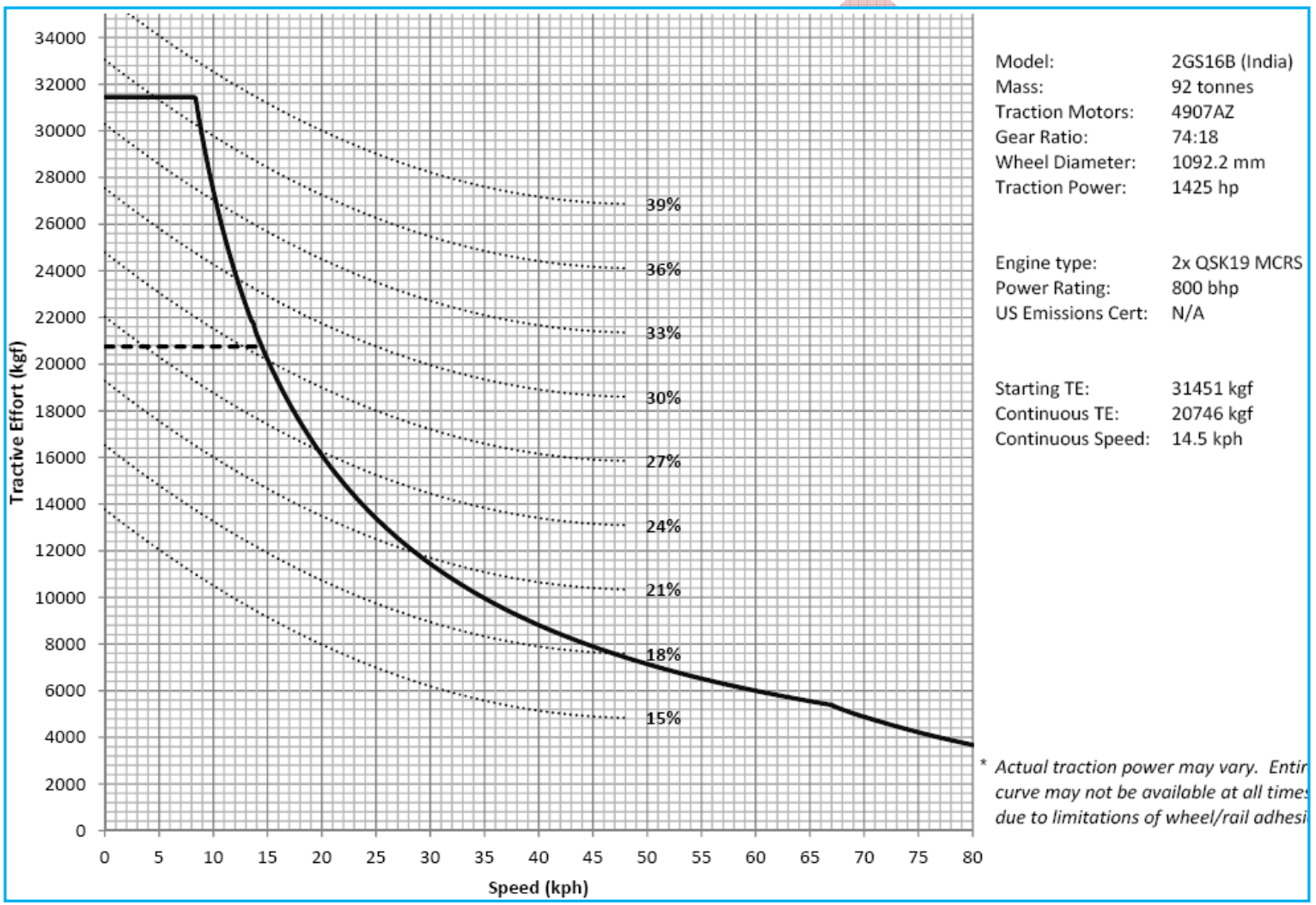
Annexure IV A

Annexure - **IV**

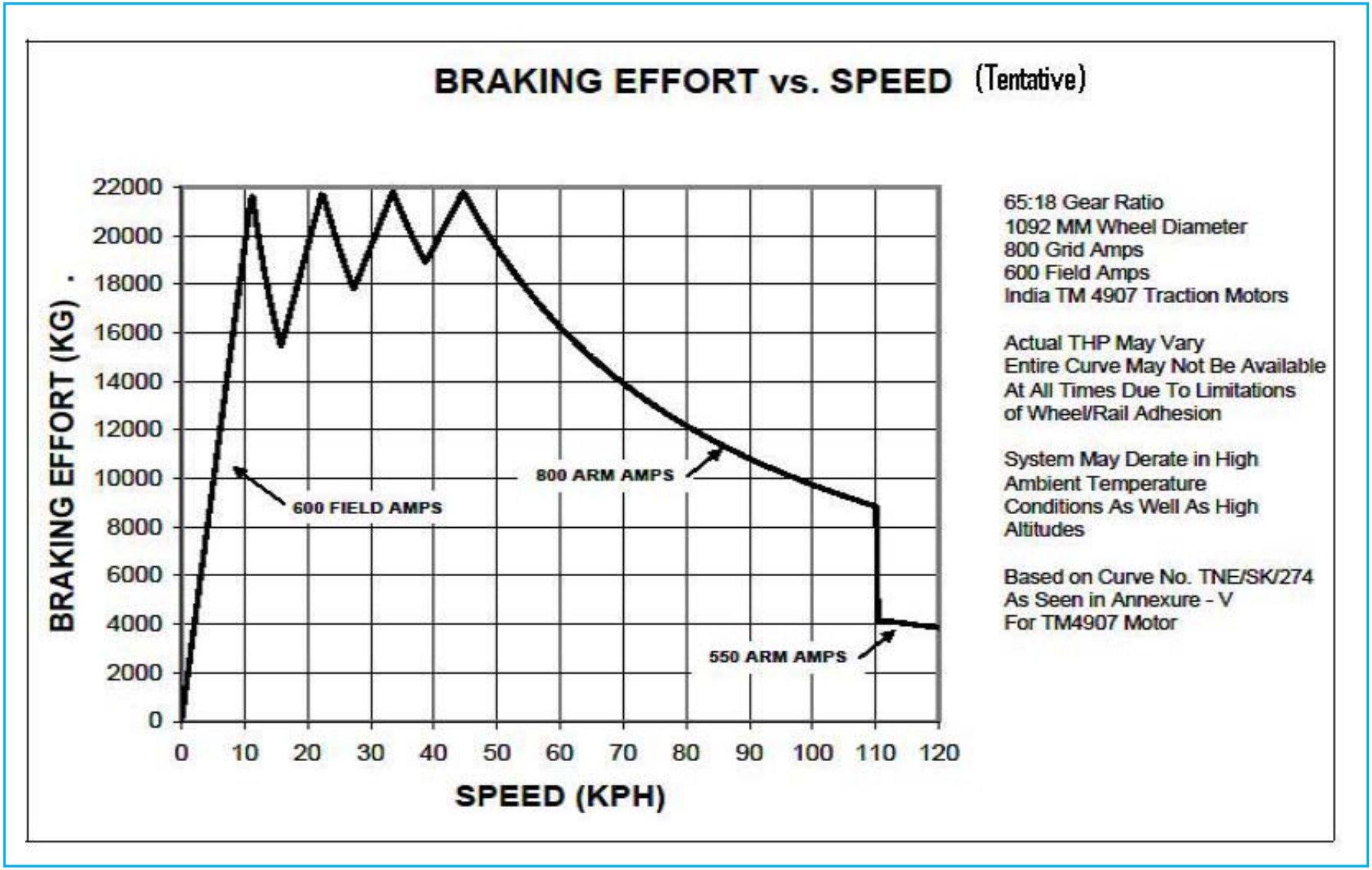


Annexure IV B

Proposed Tractive Effort vs. Speed



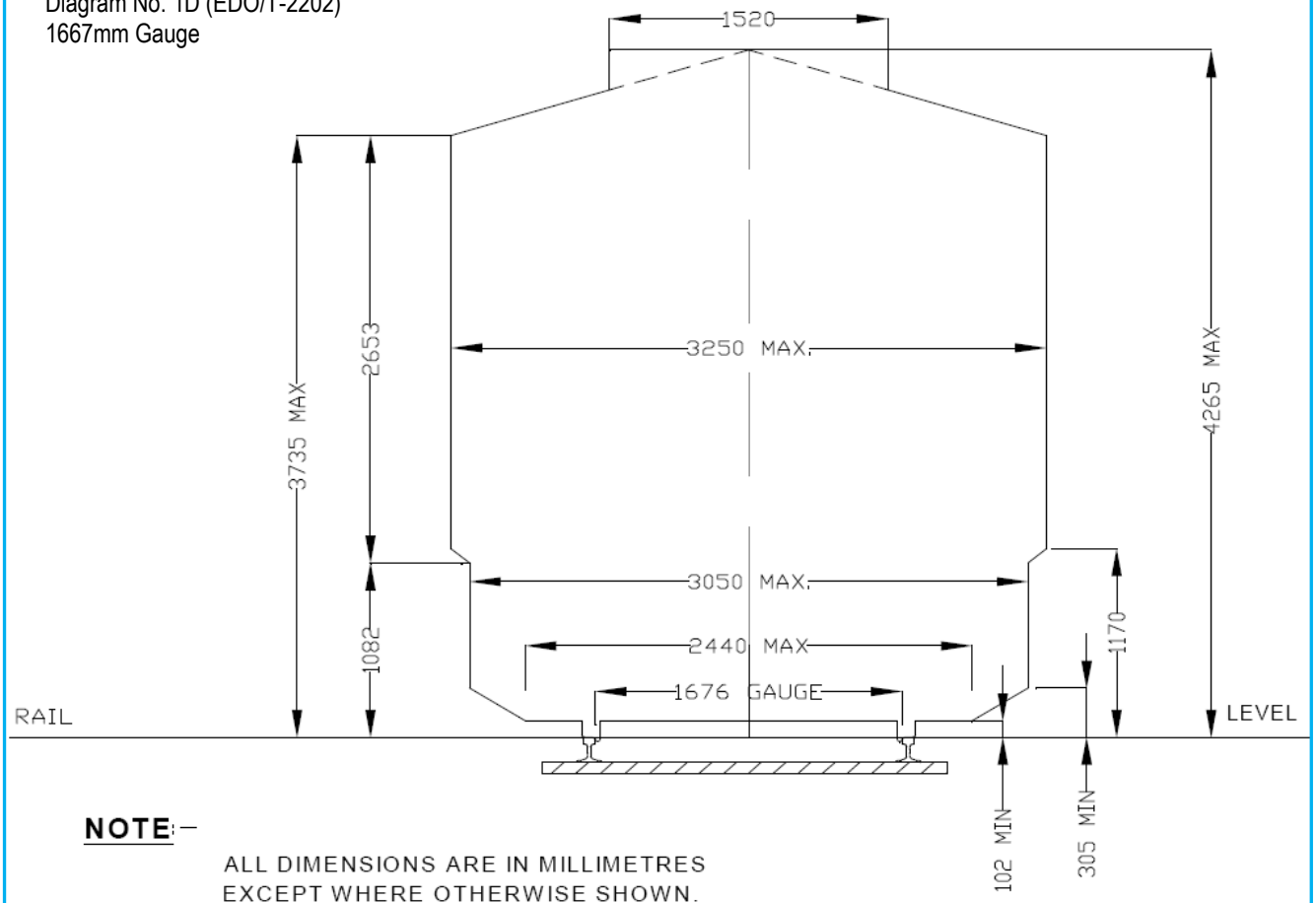
Annexure V


BRAKING EFFORT vs. SPEED (Tentative)
BRAKING EFFORT (KG) .
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
10
20
30
40
50
60
70
80
90
100
110
120
SPEED (KPH)
600 FIELD AMPS
800 ARM AMPS
550 ARM AMPS
65:18 Gear Ratio
1092 MM Wheel Diameter
800 Grid Amps
600 Field Amps
India TM 4907 Traction Motors
Actual THP May Vary
Entire Curve May Not Be Available
At All Times Due To Limitations
of Wheel/Rail Adhesion
System May Derate in High
Ambient Temperature
Conditions As Well As High
Altitudes
Based on Curve No. TNE/SK/274
As Seen in Annexure - V
For TM4907 Motor

Annexure – VI

MAXIMUM MOVING DIMENSIONS

Diagram No. 1D (EDO/T-2202)
1667mm Gauge



NOTE:–

ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.

Annexure-VII

Tentative list of parameters to be monitored through remote diagnostics

Description
Air Temp
Auto Creep Control Enable Switch
Auto Creep Control Relay
ADB Power Supply Health 1-4
AEB Reset Input
AEB Disable switch
Auto Flasher LED
AFL Pr Switch P1 Input
AFL Pressure Switch P2 Input
AFL Reset PB Input
Auto Flasher Relay Coil
Auto Flasher Relay FB
AGFB Breaker Input_(49B)
AG Armature Current
AG Arm Voltage
Aux. Gen. Field Current
AGPR Relay Coil
AGPR FB contact
Digital Air Flow Sensor Pr
Alarm PB Input_(37)
Altitude Sensor
Aux Pulse Width Modulation %
Auxiliary Generator HP
AV Solenoid_15A
Batt Earth Fault Current
Booster air pressure
Batt Charging/ Discharging Current
Battery Voltage
Blended Braking Input
Brake Cylinder Pressure
Brake Control Potentiometer
BKIV Coil
BKT-Braking Coil
BKT in DB FB contact
BKT -Motoring Coil
BKT in Mot FB contact
BP AIR Flow Input
BP Pr
Brake Power
BV Solenoid_12A
CCB Brake CALL Pressure
CCB_MR_EP_Pressure
CCB Power Supply Health
Crankcase Exhauster Breaker Input
CK1 FB contact
CK2 FB contact
CK3 FB contact
High Side CKC Coil
Low Side CKC Coil
CK Tip Weld LED_(73)
CMR Relay Coil
CMR Relay Feed back
Compressor HP
Control Unit Cabinet Temperature
CV Solenoid_7C
D1 Emergency brake input
Current Date (DD/MM/YY)
DEB CARBODY Breaker Input
DEB ENG Breaker Input
Distance traveled in Km.
DMR Relay Coil
DMR Relay Feed back
DV Solenoid_3A
External Cooling Fan Health FB
ECS Switch Input
Extended DB Contactors FB1
Extended DB Contactors FB2
Extended DB Relay Coil
Engine Speed Sensor 1 & 2 Signal
Engine Temp
Engine Over Speed Trip Input
Excitation PWM %
Equalizing Reservoir Pressure
Engine Water Pump pressure
Engine Water Temperature
Exciter Armature Current
Exciter Field Current
Exciter HP
EXPR Relay Coil
EXPR FB contact
Fire Alarm Input(Self)
Flasher Light feed back
FOL Status Flag
FOL Status Flag
Fuel Oil pressure
Fuel Pump Contactor FB
Field Shunting Contactor FB
Field Shunting Relay Coil
FOL Status Flag
Fuel Oil Level
GF Contact Coil 1
GF Contact Coil 2
GF 1 FB contact
GF 2 FB contact
GHP
Ground Indication LED_(35)
GRCO1 S/W Auxiliary Input
Grid Blower Current
Headlight Dim Input
Headlight Bright Input
Horn PB Input
Hot Engine LED_(16L)
Internal Cooling Fan Health FB
Load Control Potentiometer percentage
Lead loco
Loco coasting period
Loco DB period
Loco No.
Loco Type
Lube Oil Filter jam Input
Lube oil pressure
Lube Oil Temp
LWS I/P
Loco under Schedule attention
Max. Speed Range
Max. Tr. Motor Current
MCBG Engine RPM
MEG_Fuel rack
MEG_Lube Oil Pressure

Memory Freeze indication LED
Memory Freeze switch Input
Motoring
MR Pressure
Notch X (0- 8)
Over Load Indication LED_(RL-2)
OPS in Governor_(1B)
P1 Contactor Coil
P1 FB contact
P2 Contactor Coil
P21 Contactor Coil
P21 FB contact
P22 Contactor Coil
P22 FB contact
P2 FB contact
P31 Contactor Coil
P31 FB contact
P32 Contactor Coil
P32 FB contact
PCS Input
PCS1 Input
Pre lub Pump Contactor Coil
PLPC Contactor Feed Back
Penalty Brake
Power Setter Enable Input
Pre- post lubrication LED
R1 Contactor Coil
R2 Contactor Coil
Rectifier Blower Breaker Input
RDB Power Supply Health
Rectifier Diode Hot Input
REV Forward Coil
REV in Forward FB contact
REV Reverse Coil
REV in Reverse FB contact
Rectifier Fuse Blown Protection Input
Radiator Fan Clutch HP
RFC Supply contact (72)
S1 Contactor Coil
S1 FB contact
S21 Contactor Coil
S21 FB contact
S31 Contactor Coil
S31 FB contact
Set Speed limit
Shed name
Site HP
Self load box contactors Feed back
Self Load Box Relay Coil
Sanding Relay Coil
Loco speed in kmph
Single Phase Main Gen Input
Signal Relay Coil
Engine Start PB Input_(43E)
Engine Stop PB Input
TA Output HP
TA_Input_HP
Rectifier Output Current
Power Ground Fault Current
Rectifier Output Voltage
Tractive Effort Limit Switch Input
Tractive Effort Limit Current
Real time in hours, minutes and seconds

REVESER in reverse (LH)
Wheel Slip Buzzer
MU Fire Alarm Input
MCH 5,6,7,8 (BV)
MFPB Input
MCH 2,4,6,8 (AV)
Throttle
Brake Setup
Alarm Gong_ALG
MU Penalty Brake Input
Braking
EP Compressor Input
MCH 5,6 (DV)
ACC Input for MU
Sanding
MCH 3,4,5,6,7,8 (CV)
REVERSER in forward (SH)
Traction Motor Blowers HP
TM 1-6 Cut Out
TMX Armature Current
VCD Status
VCD Disable switch Input
VCD Status
VCD Status
VCD LED
VCD Reset PB Input
VCD Status
VCD Status
VCD Relay Coil
VCD Relay FB
Wheel RPM
Wheel Dia
Wheel Slip LED
MCB 1 & 2 in OFF
Wire 171 Input
TL30C Input
Notch Wise Engine Run Time in Hrs
Notch Wise Distance travelled in KMS
Notch Wise Gross HP in HP(hr)
Notch Wise Traction power in Kwh
Life time Data of Total Engine Run time in Hrs
Life time Data of Total Distance travelled in KMS
Life time Data of Total Gross HP in HP(hr)
Life time Data of Total Traction power in Kwh
Trip Data of Total Engine Run time in Hrs
Trip Data of Total Distance travelled in KMS
Trip Data of Total Gross HP in HP(hr)
Trip Data of Total Traction power in Kwh
Monthly Data of Engine Run time in Hrs
Monthly Data of Distance travelled in KMS
Monthly Data of Gross HP in HP(hr)
Monthly Data of Traction power in Kwh